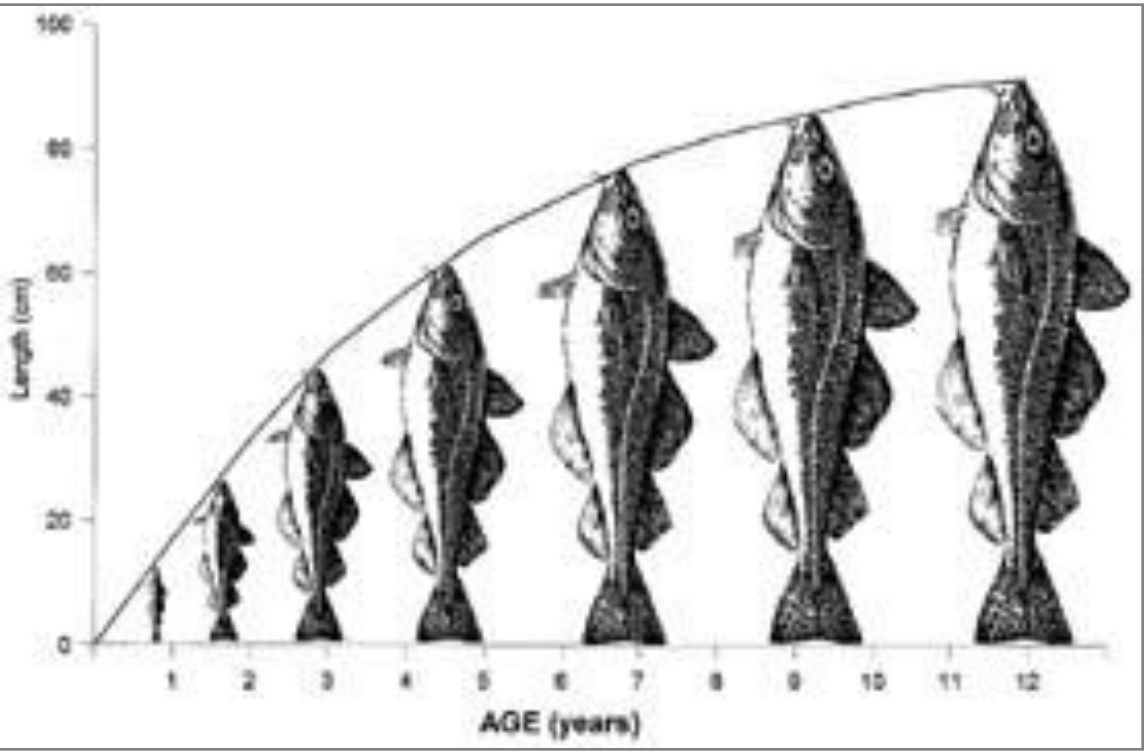
Ichthyology 3

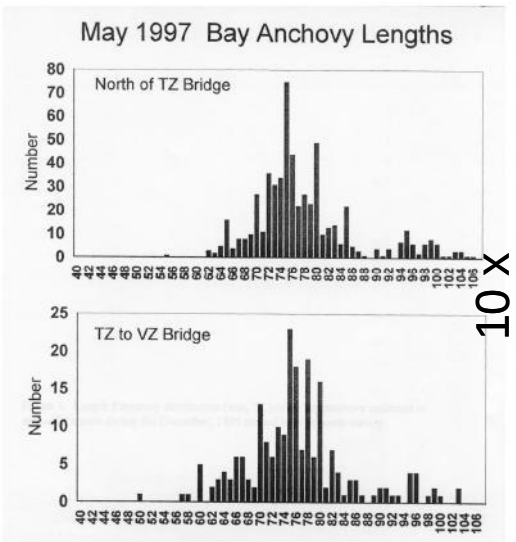
Field techniques lecture 4

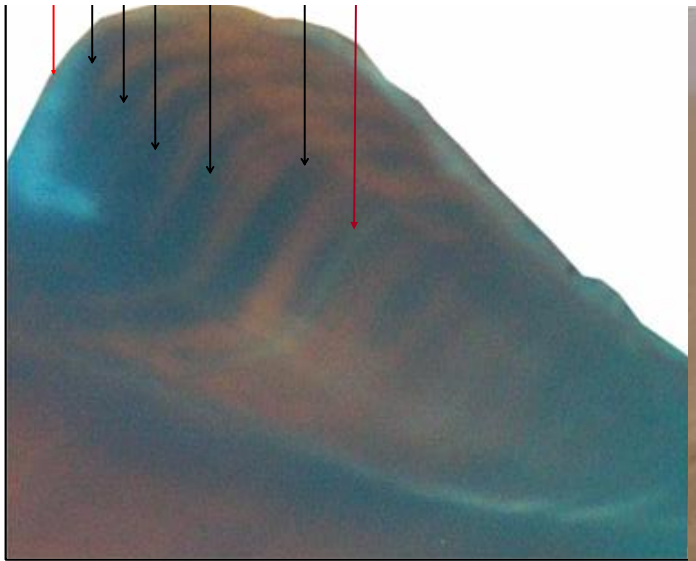
Ageing and diet analysis



Methods for age determination:

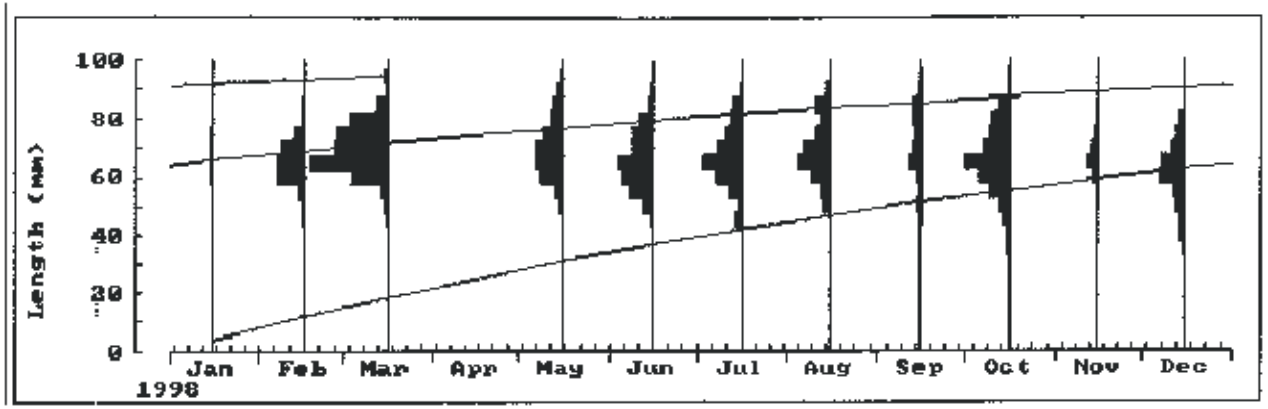
1. Length-frequency analysis
2. Hard part analysis
3. Direct Observation of individuals

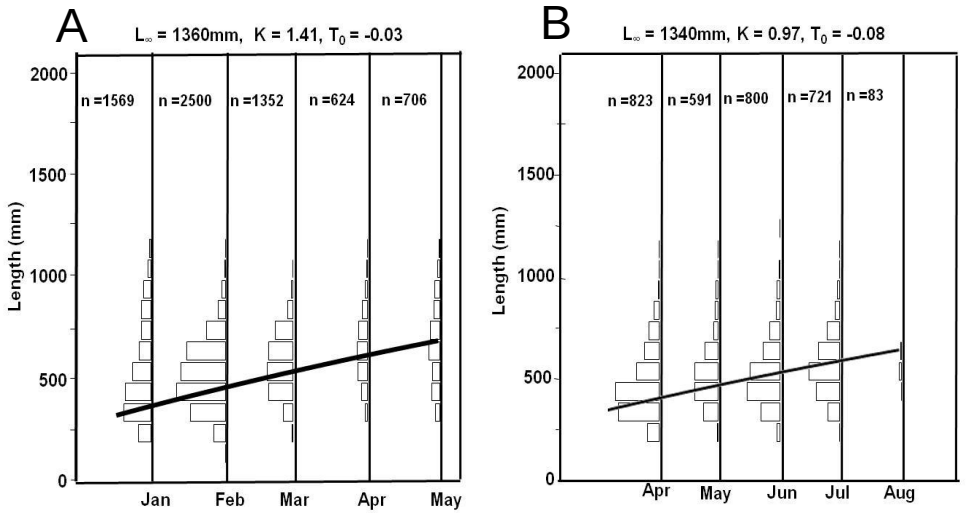




Length frequency analysis

- THEORY: Follow the progression of lengths over time. This was originally developed for tropical populations where there were thought to be no discernable growth checks on hard parts





- SUITABLE FOR: Fast growing fish with distinct spawning season or for young individuals of slower growing fish. Stable environments are better.
- DATA REQUIREMENTS – Preferably monthly but at minimum, bimonthly (every two months) length frequency data. However, if you have a very strong cohort coming through, the sampling can be less frequent.
- SAMPLING BIAS - Must assume or demonstrate that there is no gear bias? (i.e. gillnets and hook and line are not suitable (WHY???), purse seine and seine nets with small mesh size most suitable)

Hard Part analysis

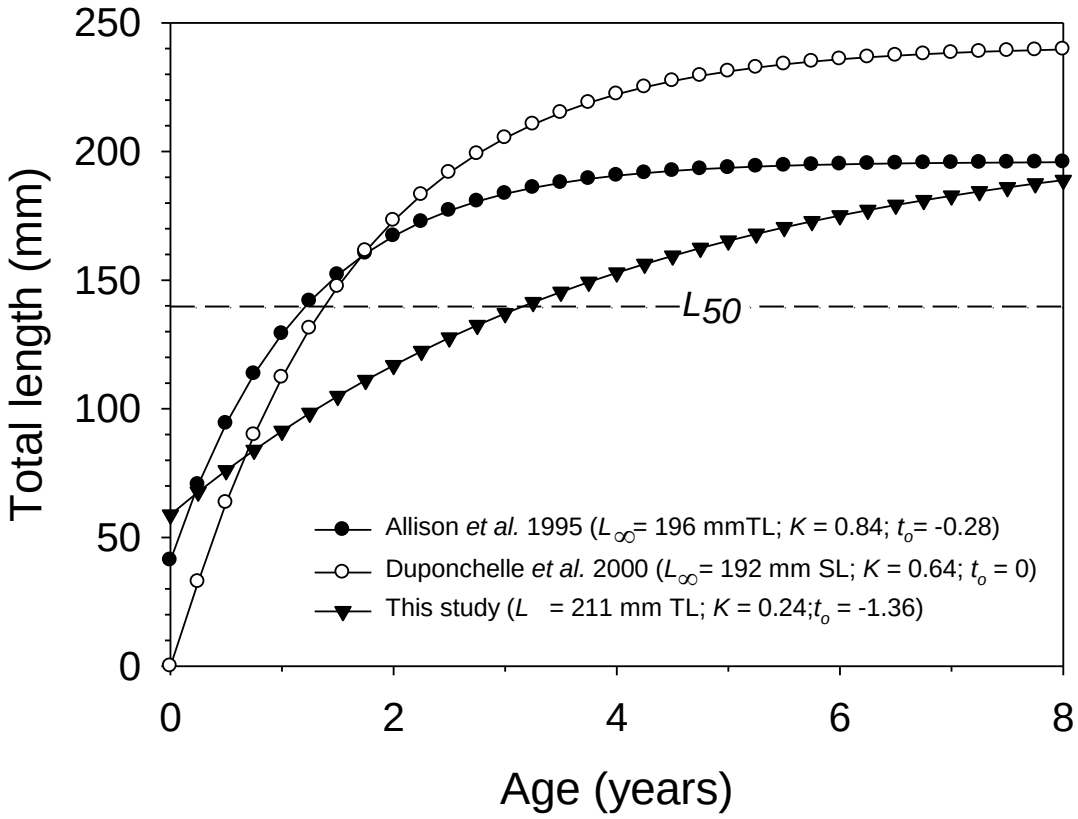
- Scales
- Vertebrae
- Spines
- Opercular bones
- Otoliths

Hard Part Analysis

- THEORY: Aging is based on the appearance of marks on a part that correspond with temporal units (years or days).
- It is thought that annual marks are related to seasonal changes in growth, while daily increments are formed by differential deposition of calcium and protein over a 24 hour period (Circadian rhythm)
- SUITABLE FOR: All fishes, although it was initially assumed that tropical fishes did not deposit marks.

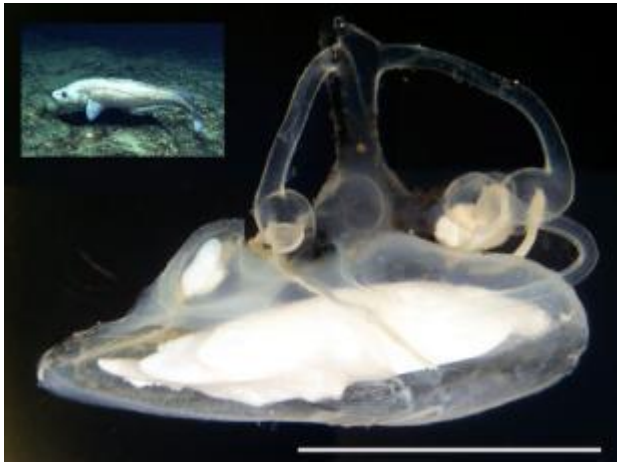
Bone (Vertabrae, spines, bones)

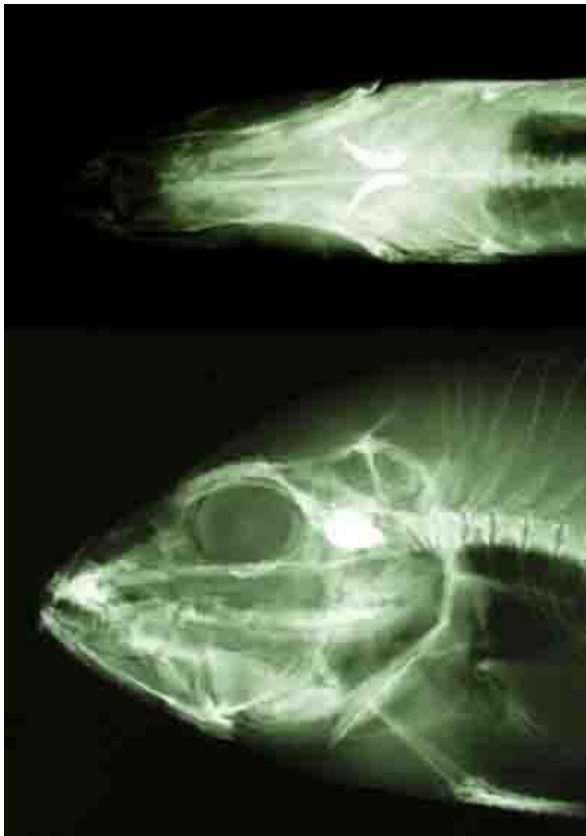
- Spines
- Monkfish the first modified spine is used for ageing.
- Opercular bones used in Tilapia.
- Vertebrae use for sharks which do not have useable otoliths.
- POTENTIAL BIAS WHEN USING BONE: Resorbtion and asymptotic growth present problems.



Otoliths

- Paired calcified structures used for balance and/or hearing.
- Annuli observed by Reibisch (1899) & daily growth increments by Pannella (1971).
- Otolith is acellular & metabolically inert.
- Otolith grows from before hatching to death.
- Currently the most popular hard part for ageing teleost fishes.





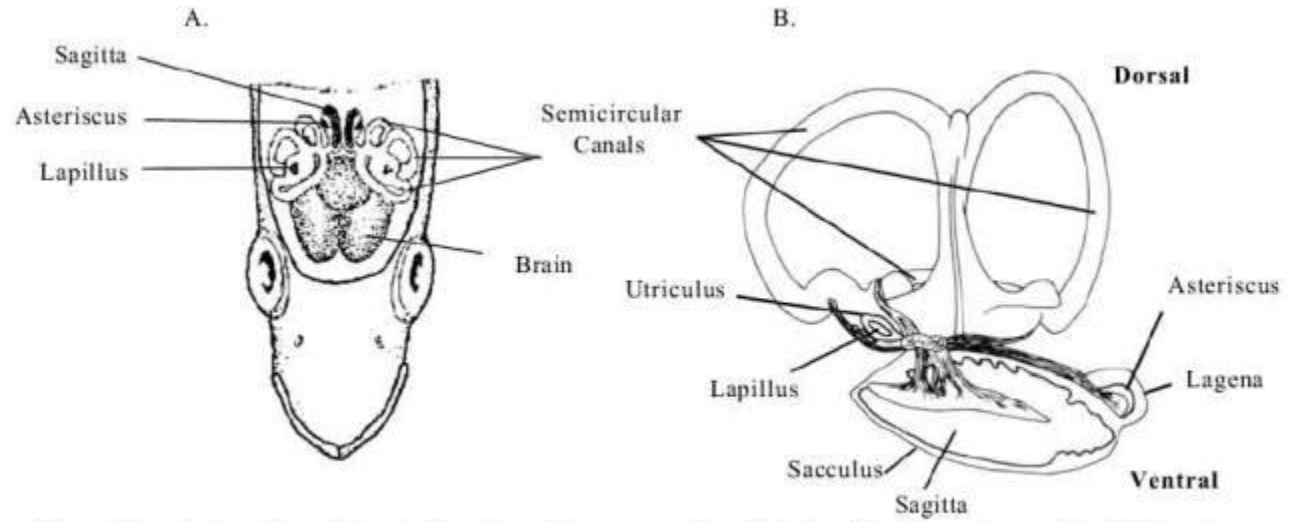
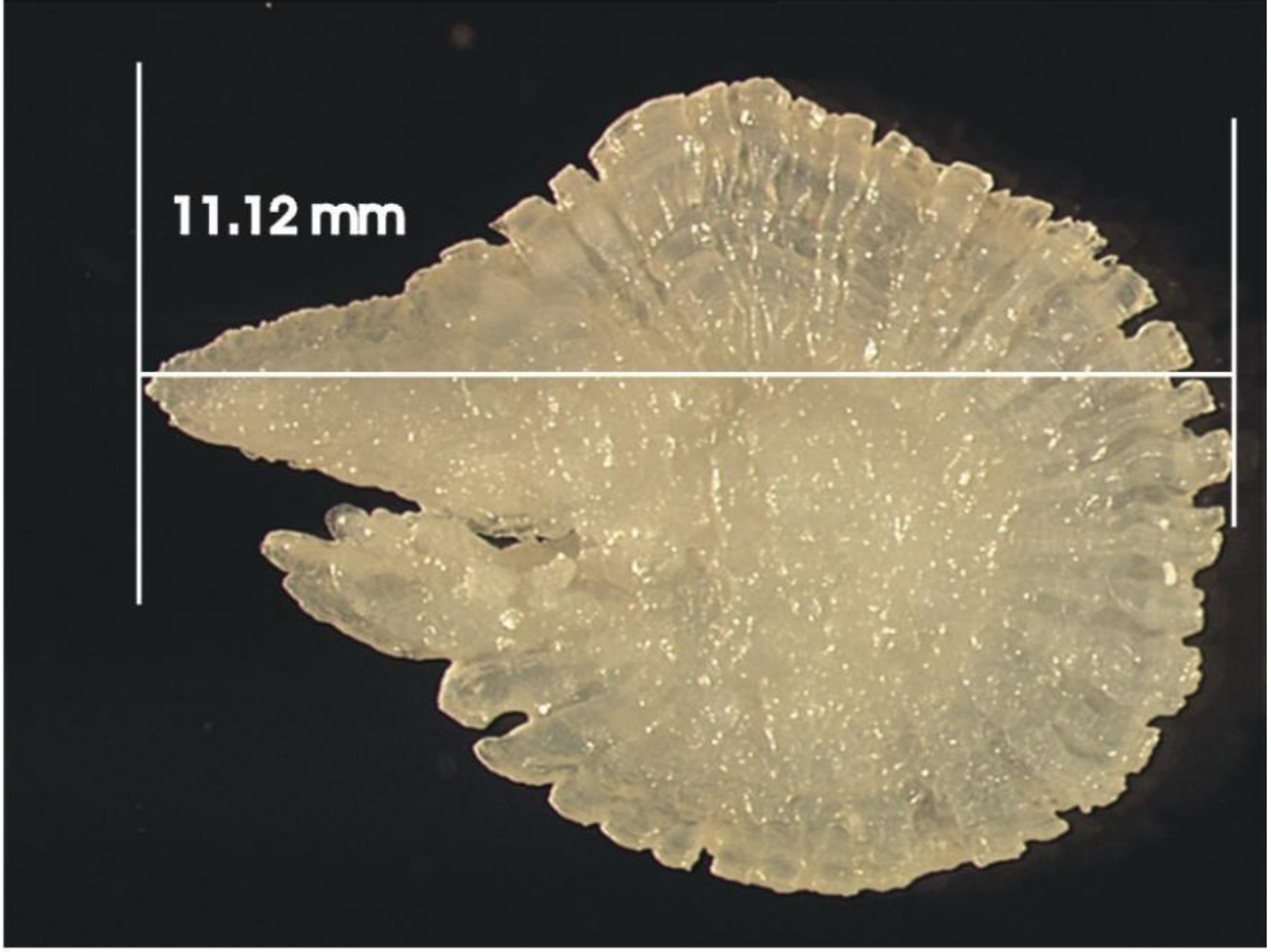


Figure 2.1. A). Location of the otolith pairs within a generalized fish (modified from Secor et al. 1991) and

Whole otoliths

Figure 3.37. Ventral posterior edge of a whole sagittal otolith from an age-5 king mackerel.



Chachama Otolith, Orinoco River, Venezuela.

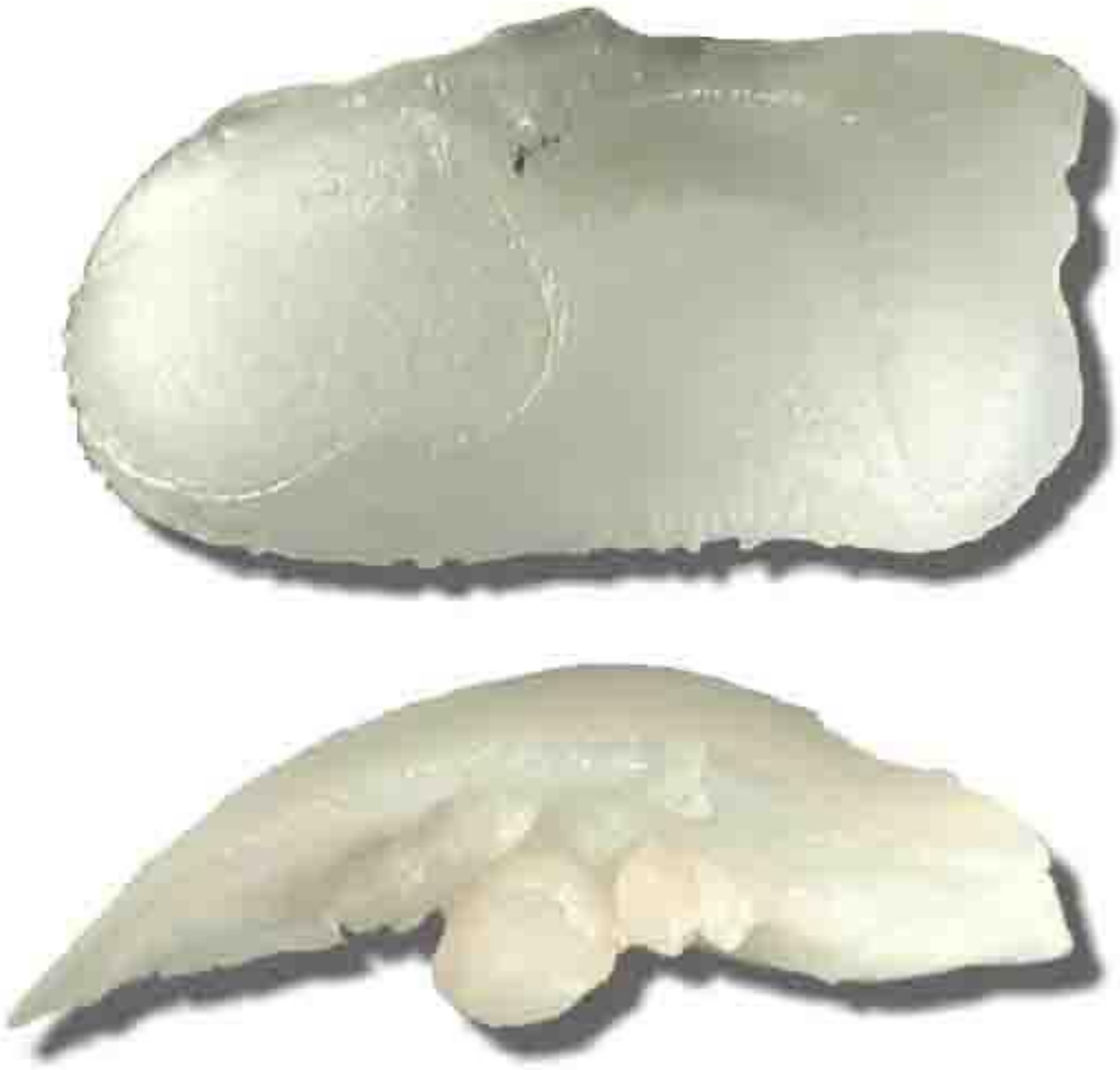


Figure 5.1 Red drum sagittal otoliths medial and top view.

Problems with reading whole otoliths

- Sometimes too thick.
- Stacking of growth zones later in life.
- OK for young and fast growing fish.
- Shown to significantly underestimate the age of many long lived species

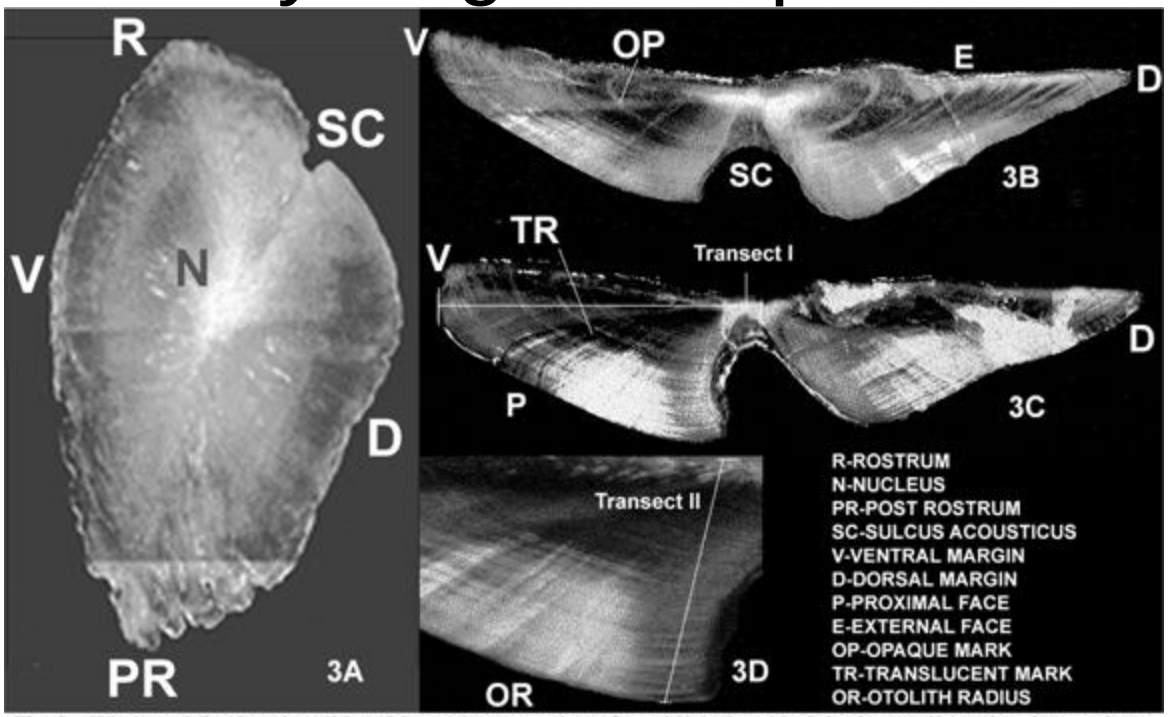
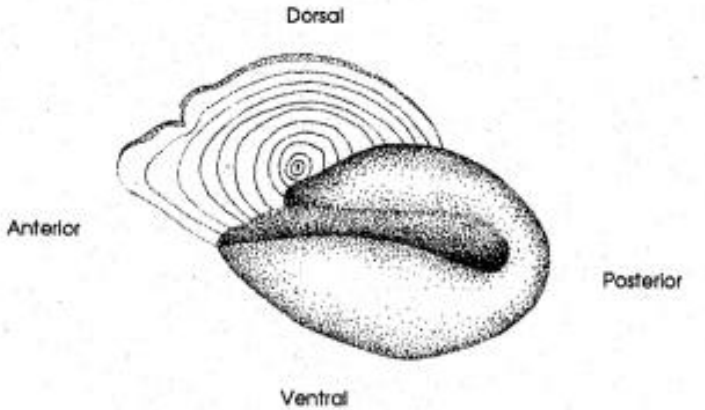
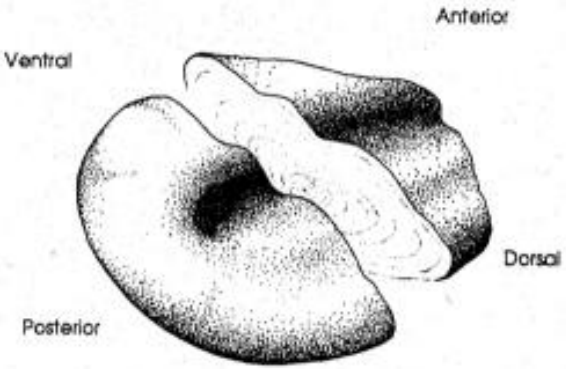


Fig. 3. Whole and Sectioned otoliths of *Lutjanus jocu* under reflected light in a black background showing the translucent and opaque bands and the different otolith regions considered for measurements.

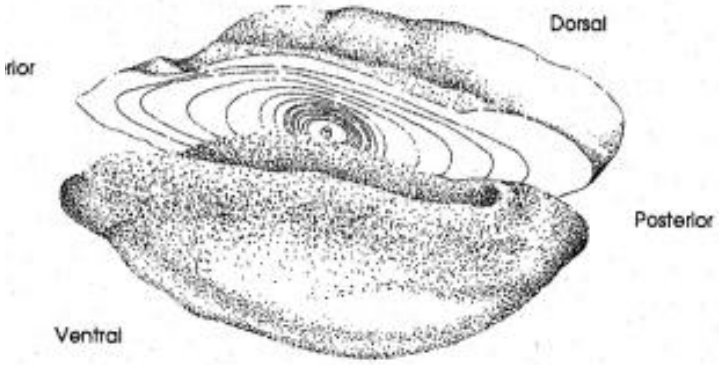
SECTIONS



Sagittal

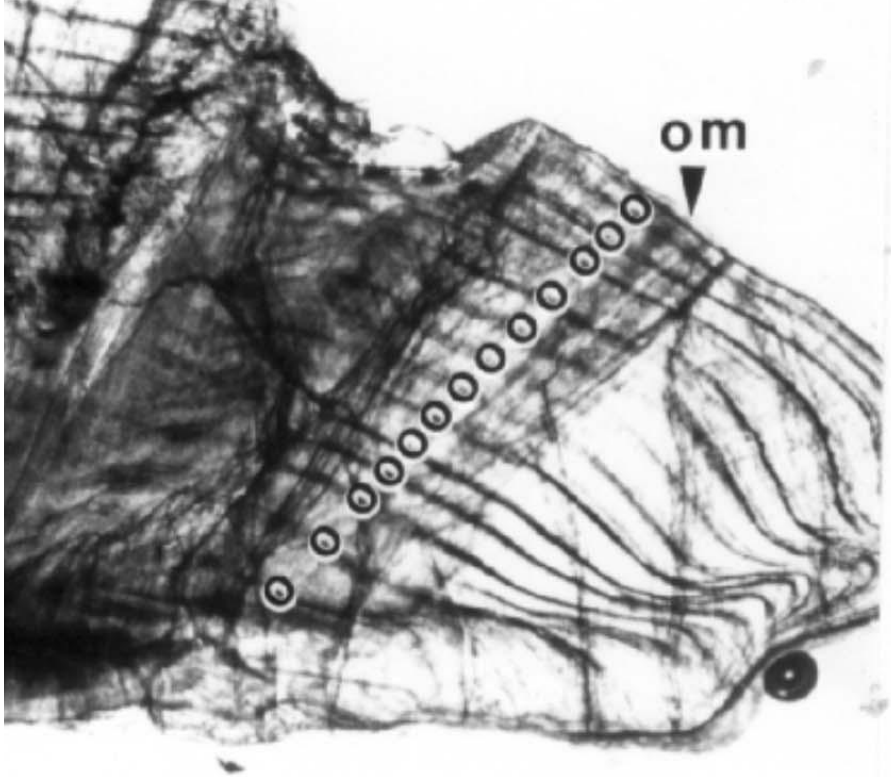


Transverse

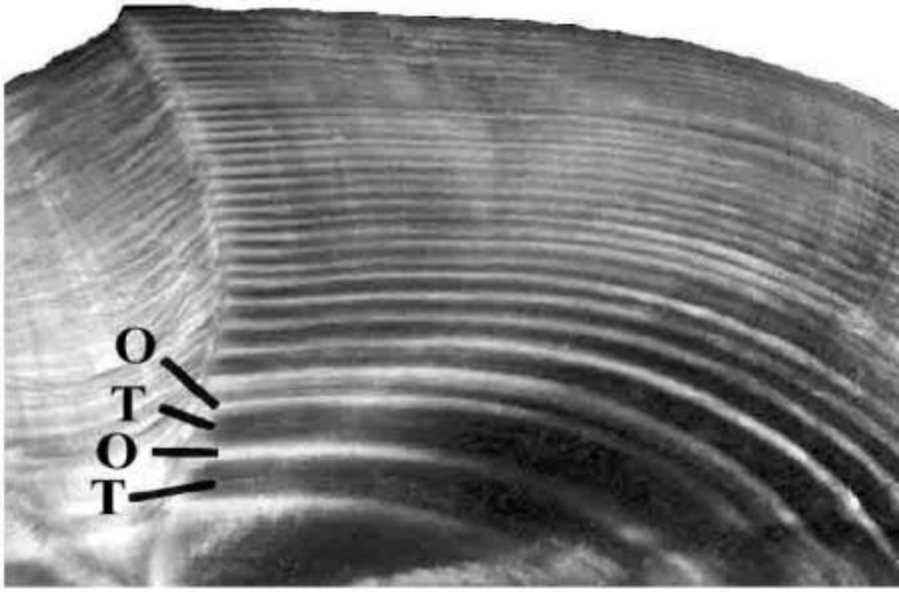


Longitudunal

Transmitted light

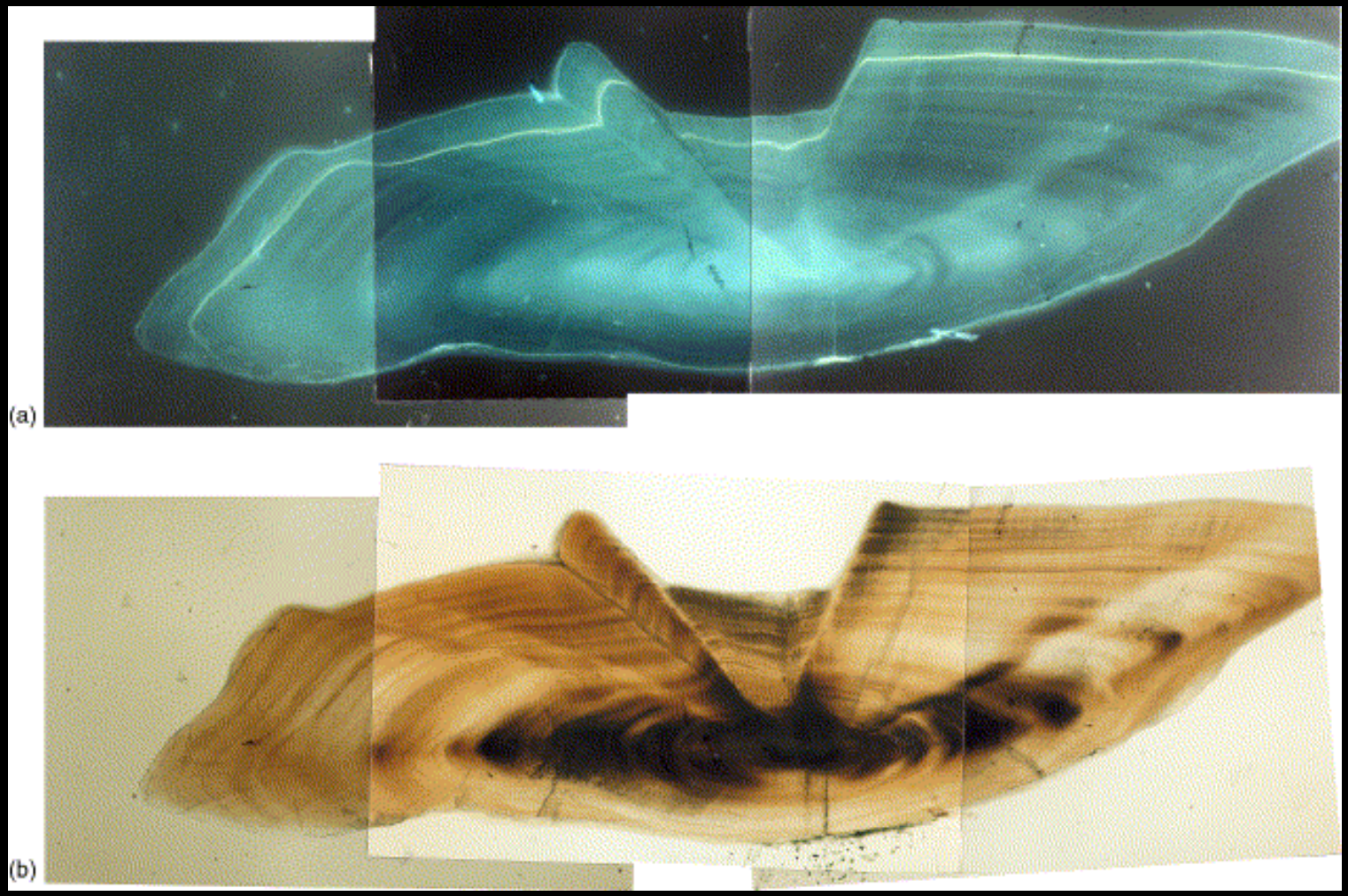


Reflected light

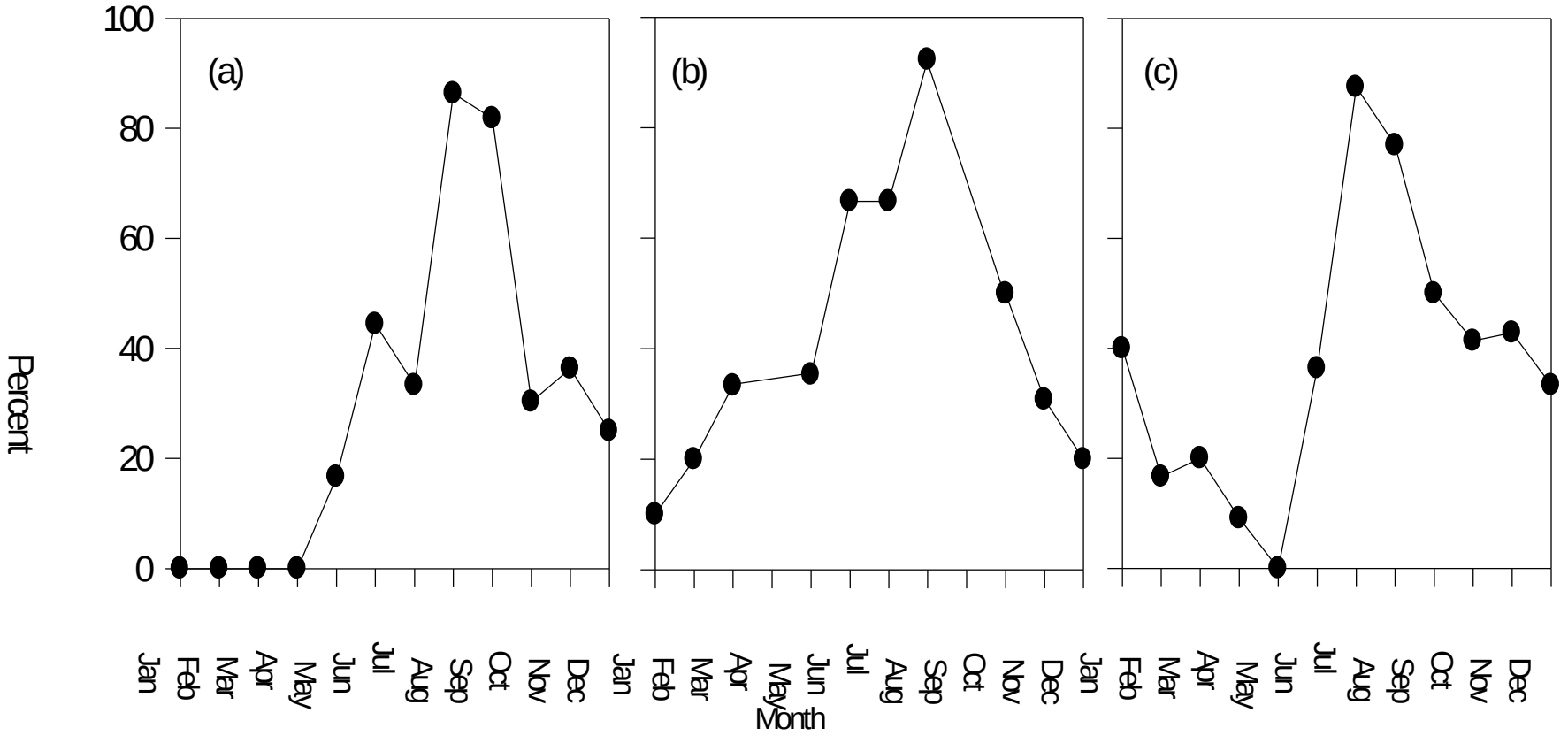


IMPORTANCE of Validation

- Oxytetracycline



Validation: Marginal Zone Analysis



- DATA REQUIREMENTS – Depends on the validation method (see Campana 2001). If using a MIA or MZA, monthly sampling (minimum n = 30) required.

- If you have another validation type (eg. Chemical marking), a minimum of 120 individuals of a wide size range required (Larger species minimum requirement is higher because they have more size classes). If there are differences in growth rates between sexes, more fish (200 or more) are required.

- SAMPLING BIAS – Gear type will not influence the results directly, but you must try to get a sample with a length frequency representative of the population under study. This often means sampling in more than one habitat with multiple gears

Direct Observations of Individuals

- THEORY: Fish are assumed to grow as they do in natural environments. Their growth rate can be monitored over time.
- SUITABLE FOR: Any species, but deep water species not possible.
- Although this is accepted to be the most direct and accurate of methods for quantifying the fish age, the are biases associated with this method.

- DATA REQUIREMENTS – Obviously it is easy to recapture stocked fish, but it is critical to recapture and measure a sample of these fish (for a length frequency histogram) at regular intervals (at least twice a year). The experiment should continue until the end of the lifespan of the fish.

- SAMPLING BIAS – If spawning occurs in the ponds, the results will be biased, especially later on in the experiment. The ponds are not necessarily always representative of the natural environment.

Stomach content analysis

Why study gut contents…

- To assess the species nutritional standing in the context of the fish community.
  - Seasonal variation
  - Comparison between sub-groups of same population.
  - Feeding intensity throughout the day.

- Estimation of total amount of food consumed by a population.
  - Calculation of daily ration or energy budget based on field or laboratory observations.

- Aquaculture
  - Larval rearing, optimal diets, daily rations, feeding regimes.

How do you do it?

No Kill - Gastric Lavage

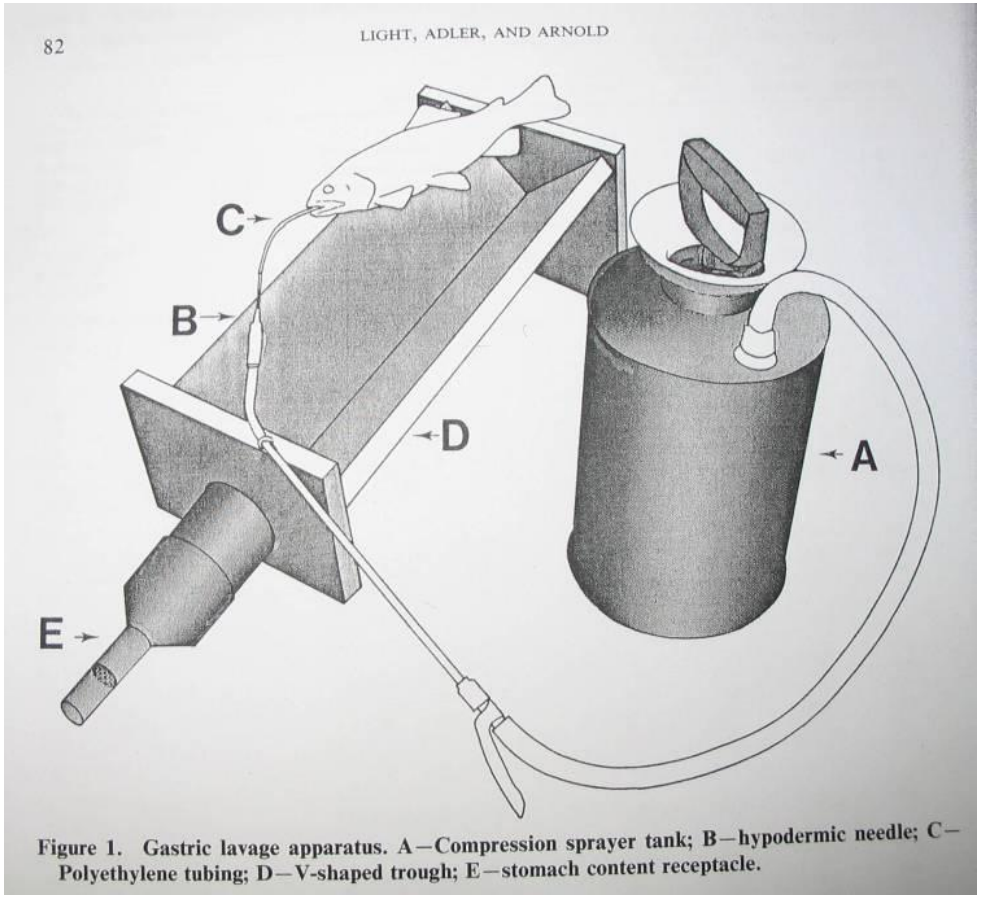
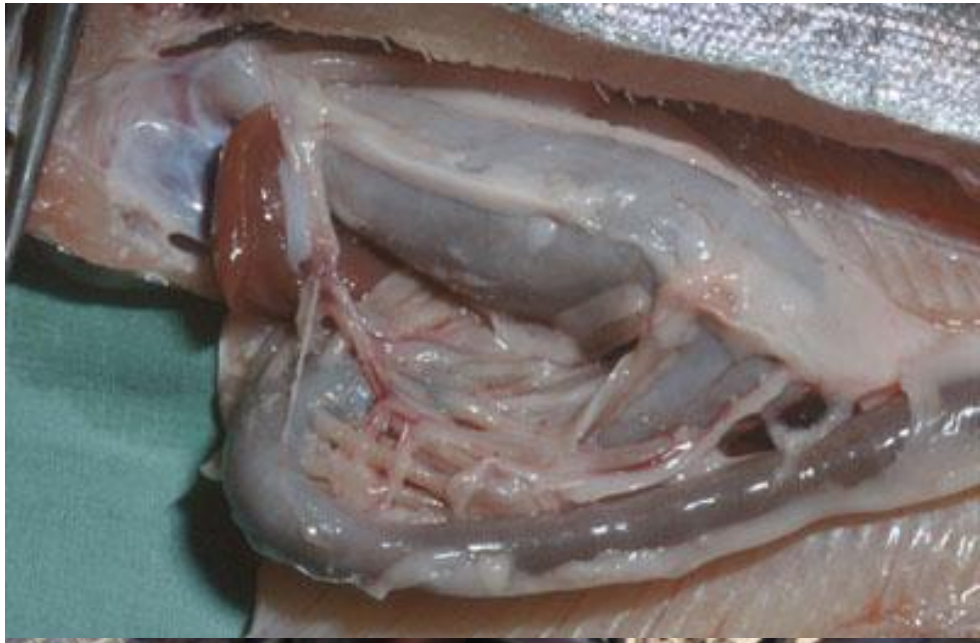


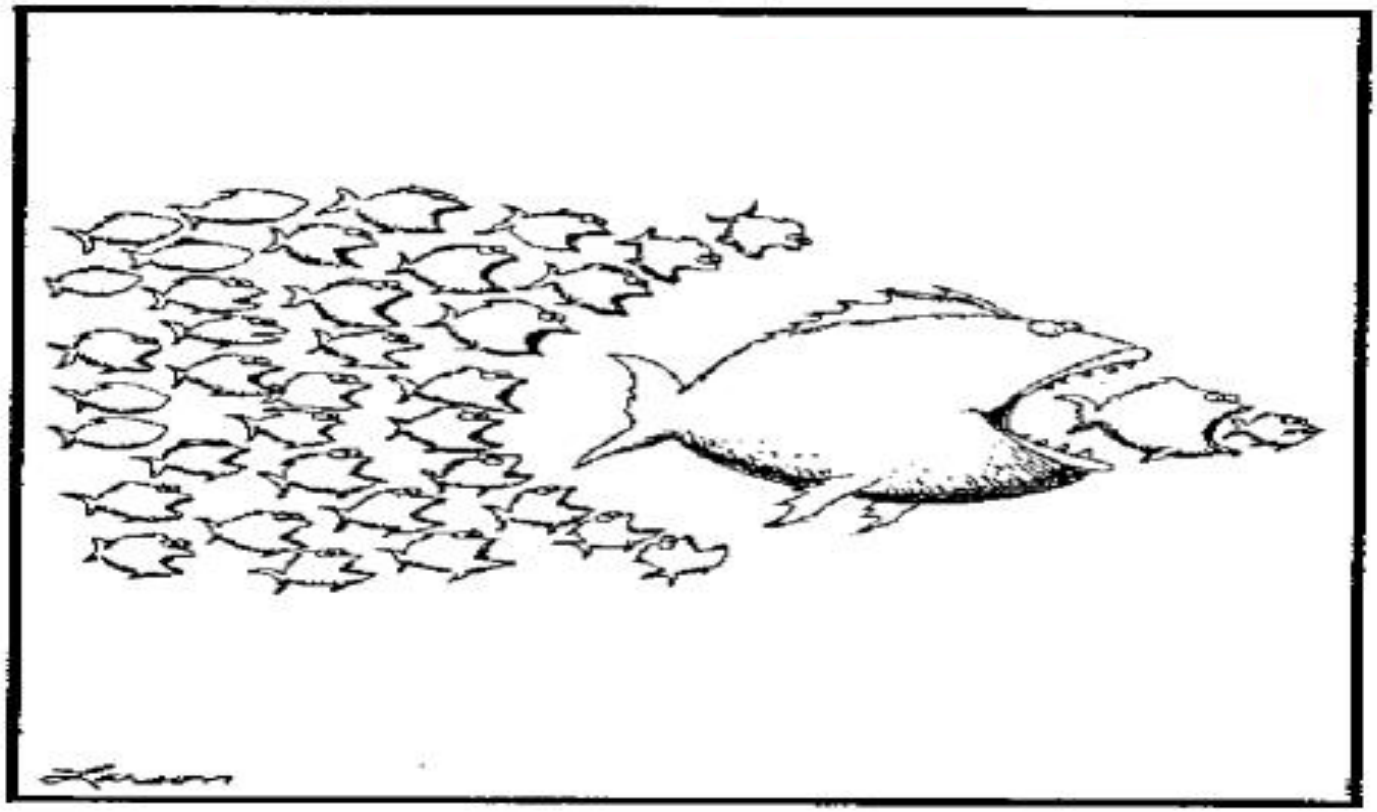
Figure 1. Gastric lavage apparatus. A—Compression sprayer tank; B—hypodermic needle; C—Polyethylene tubing; D—V-shaped trough; E—stomach content receptacle.

Removing and storage of stomach contents

- Stomach contents or the whole stomach.
- Bind stomachs or guts.
- If no stomach take only the contents from a pre-determined section of the foregut.
- Contents should be removed from the fish as soon after capture as possible.
- 10% formalin or frozen.
- Label each stomach.



Which gear should you use?

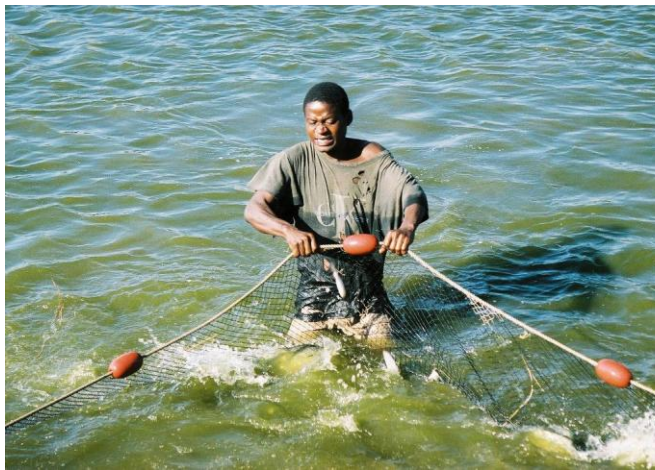


PASSIVE GEAR - Longlines, gill nets & traps/fykes

- Fish continue digesting while they are trapped/hooked/gilled (known as post capture digestion) so regular (hourly) retrieval is essential.
- Worse, they may also regurgitate stomach contents.
- You are also fishing for actively feeding/moving fish. This may affect results.
- Predatory fish in traps may actually eat other fish in the trap and this obviously affects results.

ACTIVE GEAR- Seines/cast nets/ electro fishing/rotenone (active gear)

- Very good but watch out for small fish being pushed down the gullets of large fishes during harvest.
- Regurgitation can also be a problem with all techniques.
- With rotenone, large fish often feed on dying smaller fish prior to succumbing to the poison.



– Hook and line

- May be biased as actively feeding fish are selected.
- Bait type may pollute samples
- Where one is fishing may also affect results e.g. if you are bottom fishing for kingfish then you are likely to catch those fish that are feeding near the bottom on crustaceans and miss those actively surface feeding on baitfish elsewhere.

Best practices

- Fish should be sampled with gear that allows for quick removal of the fish from the environment and that do not bias the stomach content samples.
- Remove stomachs and preserve contents quickly.
- Try to sample populations after feeding events

- Requires prior sampling to determine peak feeding times.
  - If you are trying to determine peak feeding, then you should compensate for digestion of stomach contents.

How do you describe a fish's diet?

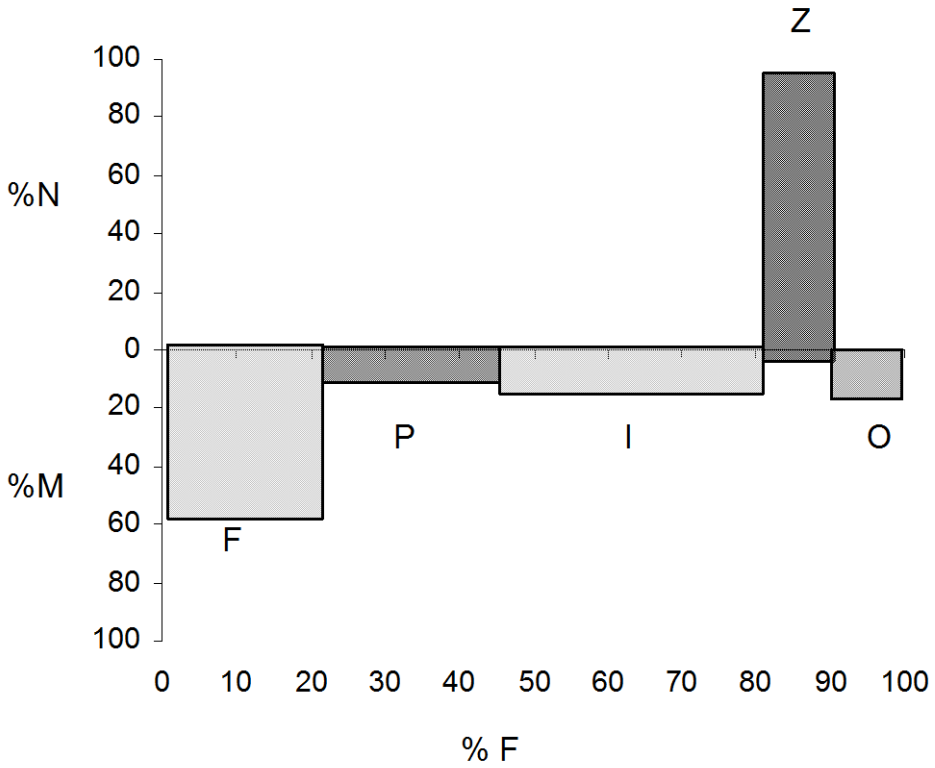
- Occurrence
- Numerical
- Volumetric
- Gravimetric
- Subjective
- IRI= (%N + %V) x %F

Table 3
Summary of stomach content analysis for *C. melampygus* based on 264 specimens containing prey identifiable to some taxonomic level[a]

Prey item	Numerical (%)	Volume (%)	Frequency (%)	% of summed IRI
Fish	*65.14*	*95.29*	*86.33*	*94.11*
Labridae (*Thalassoma duperrey*)	9.16	22.18	14.08	28.05
Scaridae	6.87	15.76	9.86	14.18
Mullidae (*Mulloides flavolineatus*)	3.82	8.1	7.04	5.33
Blennidae	3.82	7.39	6.34	4.51
Synodontidae	3.05	7.31	4.93	3.25
Gobidae	4.58	1.17	7.75	2.83
Pomacentridae	2.67	9.94	3.59	2.22
Dascyllus albisella	[2.29]	[6.95]	[3.52]	[2.07]
Abudefduf abdominalis	[0.38]	[2.99]	[0.7]	[0.15]
Acanthuridae	1.53	7.49	2.82	1.61
Chaetodontidae	0.76	8.38	1.41	0.82
Scorpaenidae	1.53	1.32	2.11	0.38
Clupeidae (*Spratelloides delicatulus*)	2.67	1.02	1.41	0.33
Sphyraenidae	0.38	2.4	0.7	0.12
Unidentified eels	0.76	0.12	1.41	0.08
Cirrhitidae	0.38	0.9	0.7	0.06
Fistulariidae	0.38	0.02	0.7	0.02
Unidentified fish	(*42.86*)	(*42.7*)	(*64.45*)	(*91.78*)
Crustaceans	*34.1*	*4.09*	*22.66*	*5.88*
Alphaeid shrimp	37.79	0.73	8.45	20.68
Stomatopods	9.92	3.13	9.86	8.18
Crabs	4.19	0.77	7.42	0.18
Pachygrapsus sp.	[0.76]	[0.18]	[1.41]	[0.08]
Charybdis japonica	[7.63]	[1.29]	[11.97]	[6.78]
Unidentified crustacean	(*1.14*)	(*0.09*)	(*2.34*)	(*0.05*)
Cephalopods	*0.76*	*0.61*	*1.56*	*0.01*
Octopus	1.53	1.17	2.82	0.48

[a] At the highest systematic level of analysis, unidentified fish were included in the total number of prey individuals. Unidentified fish and unidentified crustaceans were not included in any analysis at lower taxonomic levels. Percentages for a few identifiable species appear within

Percent mass, percent numbers and percent frequency of occurrence of major prey categories in the stomachs of *Clarias gariepinus* from (A) Katriver reservoir; F = fish prey, P = plant material, I = insects, Z = zooplankton, O = other.



Potts et al. 2008

	%N	%M	%F	IRI
Fish	0.02	52.81	53.49	2825.54
Plants	1.12	7.80	58.14	518.97
Insects	0.41	10.48	90.70	987.71
Zooplankt	98.37	1.25	25.58	2548.27
Other	0.11	22.96	32.56	751.31

Best practice.

- Use more than one method to describe diet.
- Split fish into size classes when describing the diet.
- Use fish size weight in gravimetric studies.